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ELECTRIC PUMPING EQUIPMENT ON THE STEAMER LA BREA.

BY HUGO P. FREAR.

ELECTRIC COOKING.

BY E. A. WILCOX.

WATERPOWER'S PRESENT STATUS.

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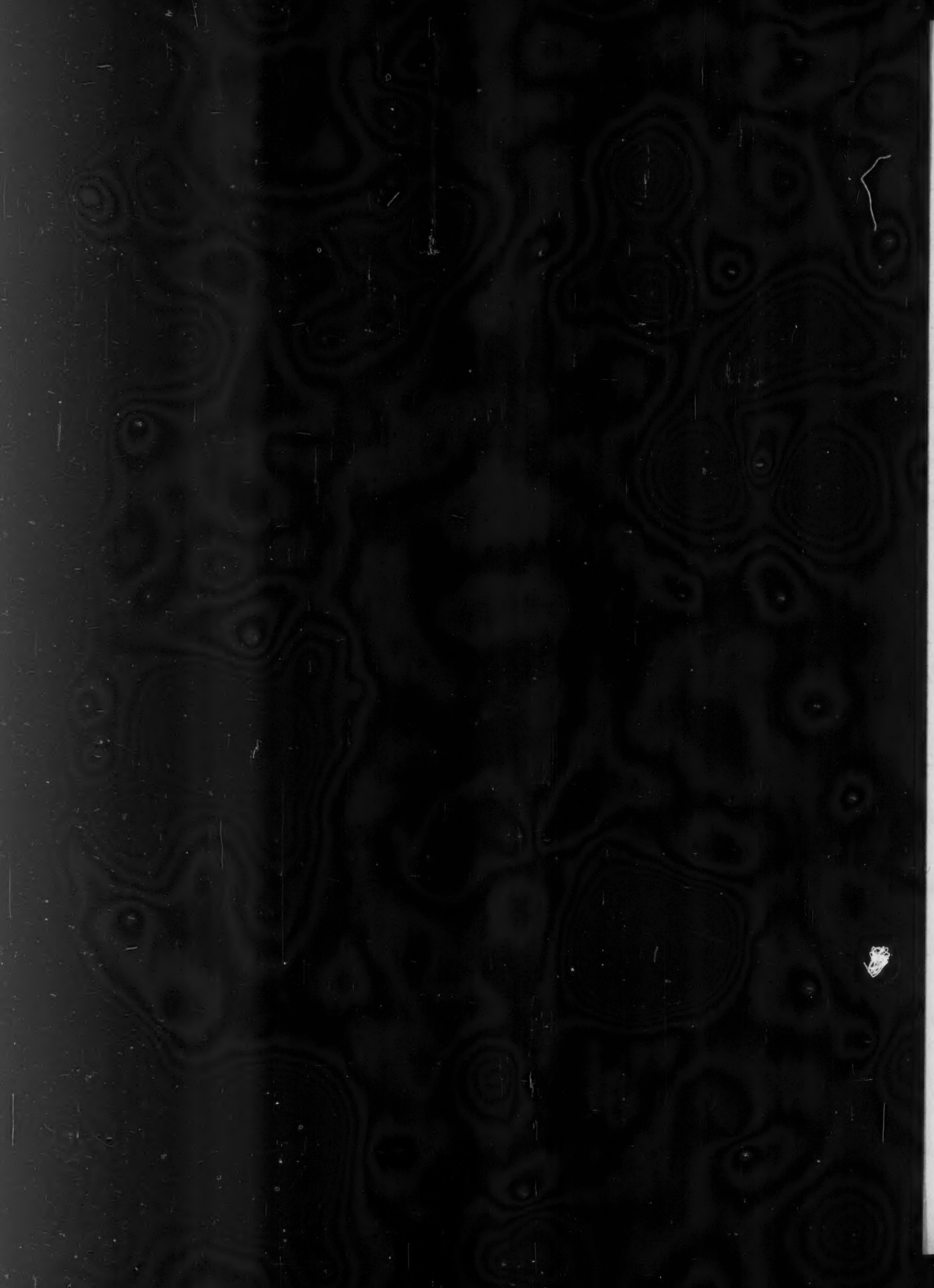

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ELECTRIC PUMPING EQUIPMENT ON STEAMER LA BREA

BY HUGO P. FREAR.

(In view of the tremendous increase in shipbuilding on the Pacific Coast recently, this article should be of widespread interest. It gives details of the steam turbine drive and electrically driven oil pumps with which the vessel is equipped. It is slightly condensed from a paper presented at the November 15th meeting of the Society of Naval Architects and Marine Engineers in New York City.—The Editor.)

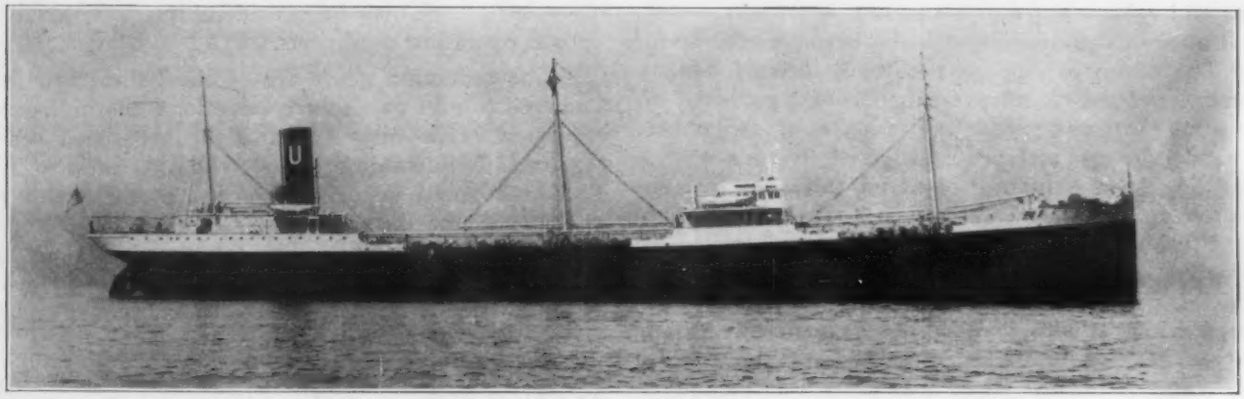

Fig. 1. S. S. La Brea in Ballast Trim.

The S. S. La Brea is the first oil tank steamer equipped with independent submerged cargo pumps in each compartment, port and starboard, operated by electric motors on deck, and also the first to be fitted with reduction gear turbines, so far as the writer knows. Otherwise the vessel differs little from many tankers built on the Isherwood longitudinal system of framing, and therefore these two items, especially the electric pumping system will receive the most attention.

The La Brea is 435 ft. in length, 56 ft. in breadth and 33 ft., 6 in. in depth, moulded, and was the first vessel of this particular class built by the Union Iron Works Company, San Francisco. The contract was dated May 14, 1915, and delivery made February 29, 1916.

There have since been completed or contracted for, by the same builders, thirteen additional tankers off the same scrieve, all with pump rooms and ordinary pumping systems except one vessel for the Pan American Petroleum Transportation Company, which will have the same pumping system as the La Brea, but with only one pump to each transverse cargo compartment in lieu of two as fitted on the La Brea.

Ten of these additional tankers have reduction gear turbines and three triple-expansion reciprocating engines of approximately the same indicated horsepower as the shaft horsepower of the turbines. In each case the length of machinery space, forehold and overall length of the oil compartments, including pump room and coffer-dams, are the same. The position of the pump room, coffer-dams, length of fuel tank and length of some of the cargo tanks vary more or less to suit the owners' views.

Of this class, the tanker following the La Brea was the Los Angeles, also for the Union Oil Company of California, but fitted with triple-expansion reciprocating engines, pump room and ordinary pumping equipment of standard capacity and efficiency. These two vessels, delivered within a month of each other and owned and operated by the same company, offer a most excellent opportunity for a comparison of their performances on the voyages so far completed.

For a general description of the La Brea the reader is referred to Fig. 1, showing the vessel afloat, and Fig. 2, showing profile inboard. On account of the limited scope of this paper, attention is called only to the reduction gear turbines and location of cargo pumps and motors indicated on the profile inboard and upper deck. Tanks 1, 2 and 3, are much smaller than the remaining tanks and have an independent discharge line. These were intended for light distillates, but have not been used for that purpose up to the present time.

The propulsion equipment was furnished by the General Electric Company and consists of a Curtis turbine of the type developed for ship-propulsion work,

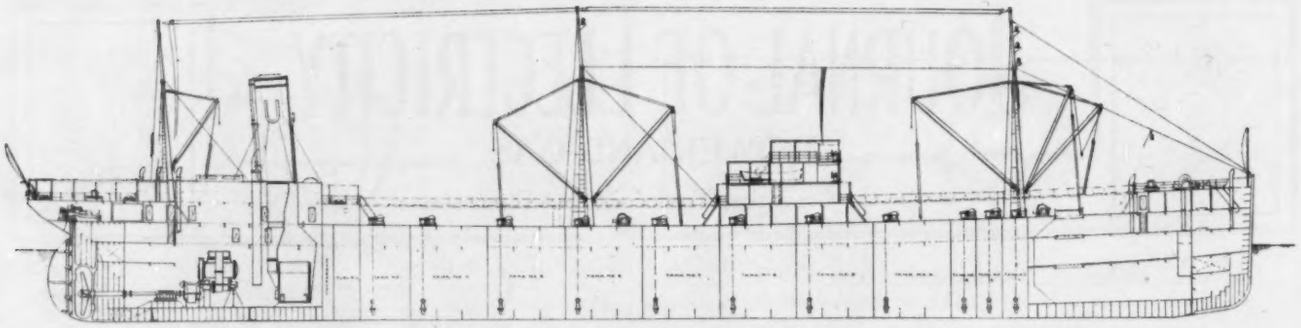

Fig. 2. Inbound Profile of S. S. La Brea.

operating at a speed of 3500 revolutions per minute, direct-connected to a double reduction gear suitable for reducing the speed of the turbine to 90 revolutions for driving the propeller (see Fig. 3). The normal rating of the turbine and gear is 2600 brake h.p., with a steam pressure of 200 lb. at the throttle valve, 50 deg. superheat and exhausting into a vacuum of 28½ in., measured at the exhaust inlet with the barometer at 30 in.

The steam turbine consists of a forward 5-stage element and a 2-stage reversing element mounted on the same shaft and exhausting into the same chamber. Control of these turbines is affected by means of a throttling lever actuating balanced valves located respectively in the steam lines to the ahead and reverse turbines. Speed of the turbine is controlled by throttling, and there is also provided a hand-operated stop-valve in the reverse line which is normally kept closed while at sea, in order to prevent any possibility of leakage of steam into the reversing turbine. This valve is opened when it is desired to maneuver or make a landing.

The ahead turbine consists of five Curtis stages as stated above, the first or high-pressure stage carrying two rows of buckets and the remaining stages a single row of buckets. The buckets for each stage are mounted on a rolled steel plate wheel, into the periphery of which the buckets are dovetailed in a manner developed by the General Electric Company and successfully used for many years to meet the severe requirements of central station turbines. Steam enters each stage successively through nozzles carried in the diaphragms between each stage.

The reversing turbine is of the same construction as the head turbine, with the exception that it consists of two stages only, of smaller diameter. The reversing turbine is capable of developing two-thirds torque and two-thirds speed with the same steam flow taken by the ahead turbine under normal operating conditions. The nozzle capacity, however, is greater than that of the ahead turbine, so that the requirement of reversing power may be considerably exceeded under normal operating conditions.

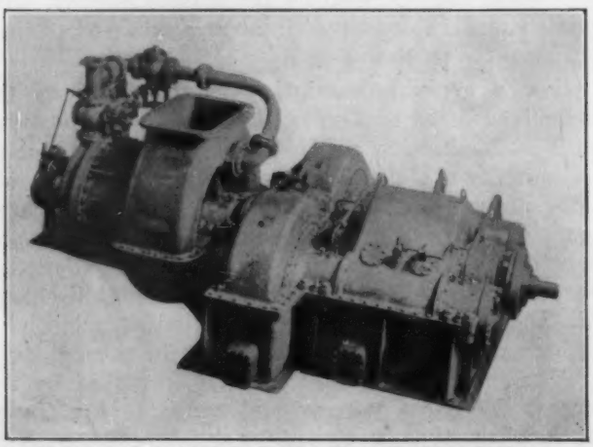

Fig. 3. Assembled Reduction Gear Turbine, 2600 h.p.

The reduction gears are of the helical type and arranged to give two speed reductions, the high-speed reduction ratio being 5.03 and the low-speed reduction ratio 7.75, making a total reduction ratio of 39.1. The high speed or driving pinion meshes with the two gears, one on each side, the three shafts lying in a horizontal plane. The low-speed pinions are mounted on the same shaft as the high-speed gears. The adjustment is such that work is divided equally between the two low-speed pinions.

The high-speed gears are built in accordance with the "Alquist" patents and consist of a number of rolled steel plates, each 1 in. thick and thinned out near the center in order to give a certain degree of flexibility, thus insuring equal distribution of the work through the total face of the teeth. This construction has been found not only to give smoothness and lack of noise in operation, but has also resulted in a great reduction in the wear of the gears and pinions.

Slip couplings are provided between the high-speed gears and low-speed pinions in order to prevent any movement of the main thrust shaft being transmitted to the turbine.

The turbine bearings and gears are supplied with oil under pressure of about 10 pounds. The oil is circulated by means of steam pumps which take oil from the main tank, where it is first forced through a strainer and then through a cooler before being delivered to the turbine bearings and the spray nozzles delivering oil to the gears. Oil is also supplied under pressure to the various bearings of the gears and pinions.

The complete weight of the turbine and reduction gear, including all parts for the throttle valve and thrust shaft coupling, is about 110,000 pounds.

The electric cargo pumping system is the result of much labor and study on the part of Mr. O. B. Kibele, general superintendent of transportation for the Union Oil Company of California, who, with the able assistance of the San Francisco office of the General Electric Company, perfected all of the details.

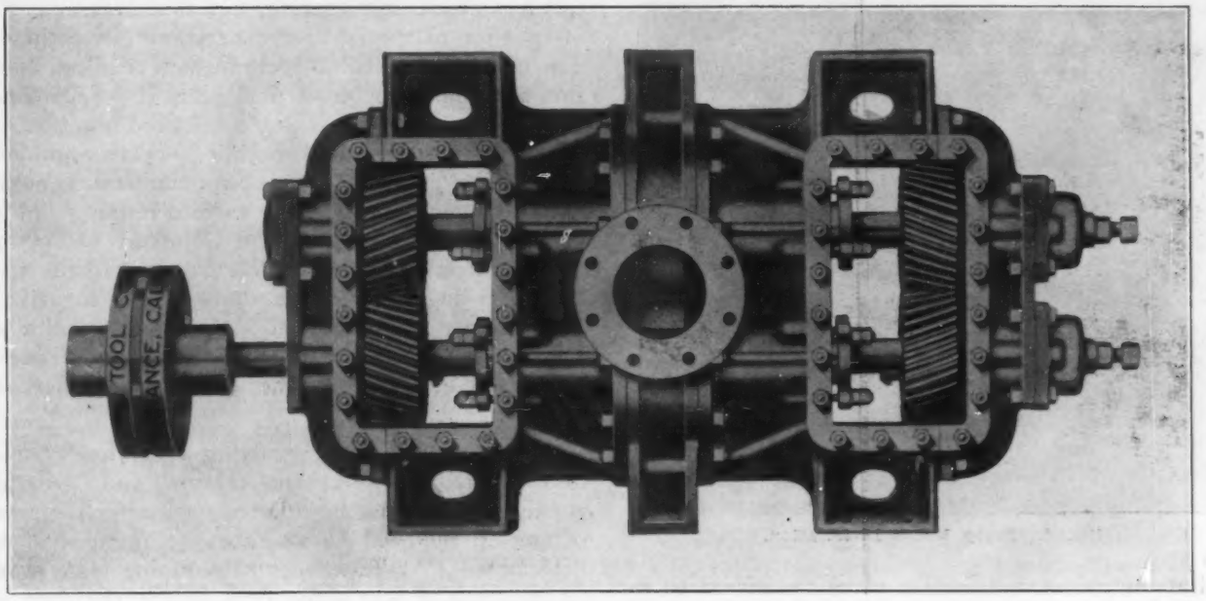

Fig. 4. 4-in. Ideal Rotary Pump with Gears Exposed.

The writer is indebted to both for much of the material worked into this paper.

The installation consists of twenty-two Ideal 4 in. rotary pumps, built by the Union Tool Company, Torrance, California, (Figs. 4, 5), and are designed especially for handling highly viscous oils, molasses and creosote, and are also fitted with a steam jacket for handling asphaltum. Each pump can deliver 350 gal. per minute against a total head of 350 ft. at 200 revolutions per minute. The pumps are secured in the bottom of each compartment of the vessel, port and starboard to brackets that are integral with the tanks, and are driven by 40 h.p., 3-phase, 60-cycle, 220-volt motors. The discharge line for the three small tanks forward have nine 4 in. discharge gates, while the separate discharge line for the remaining tanks have fourteen 6 in. discharge gates.

The motors are located on the upper deck contained in a watertight and gas proof casing (Fig. 6). The drive to the pumps is through a set of bevel reduction gears and a vertical shaft which transmits the power through flexible couplings to the pumps.

The shaft is entirely enclosed in a casing which serves as an oil reservoir, so that all of the shaft bearings and the pump gears are operated in an oil bath.

The pumps are each fitted with enclosed carbonized spiral gears, top and bottom, and operate with a minimum of noise. The vertical-drive shaft is hung on a ball thrust bearing contained in the gear case. They are fitted with 6 in. suctions and 6 in. discharges, so arranged that each pump can take suction from either or both compartments, port and starboard, at the same time, or independently. Cargo may also be discharged with one pump or as many pumps as can be put into operation at one time, depending entirely on the capacity of discharge pipes to the shore tanks. Any number of commodities can be discharged at the same time without mixing, depending, of course, on the number of discharge lines that are available to the shore tanks. The discharge lines from the pumps are so arranged that they can be also used as filling lines to each individual tank, by means of a bypass round the pump.

Both Mr. Kibele and the writer, from the start, believed that half the number of pumps would meet all requirements, but finally decided to take no chances on the first installation. The better and more economical plan would be to connect the smaller number of pumps to a common 6 in. suction line, fitted with gate valves at each bulkhead and independent suction to each tank. This would enable each pump to draw from all or any of the tanks and insure maximum elasticity in the event of one or more pumps going out of commission.

All operating valves are located on the upper deck. The motor control for starting the pumps is located in the main engine room and will be described in more detail hereafter. When it is desired to start any par-

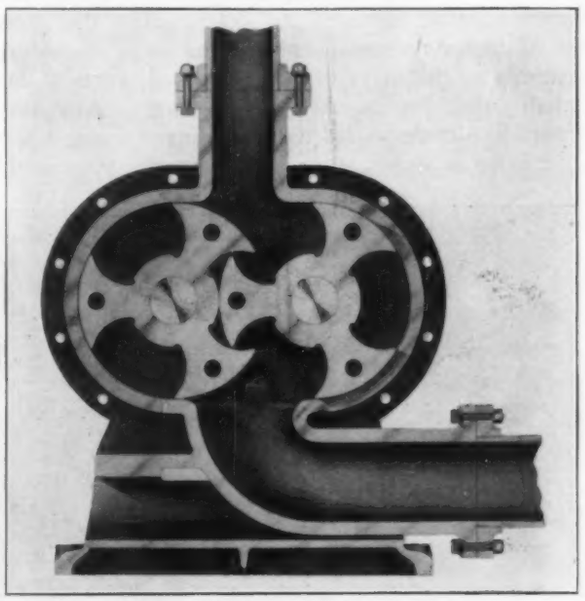

Fig. 5. Ideal Rotary Pump Rotors.

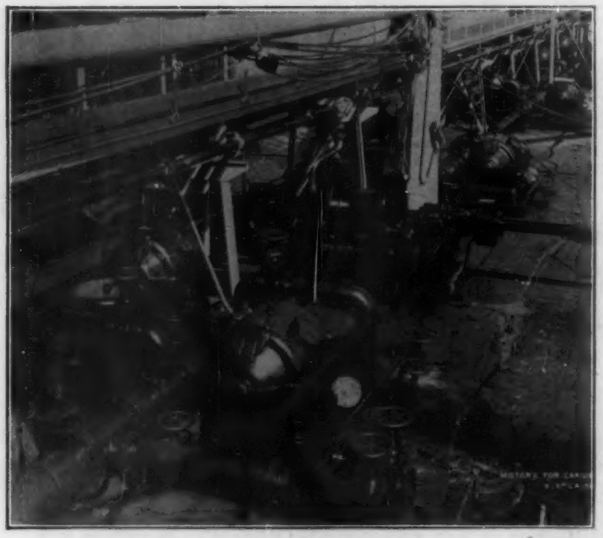

Fig. 6. Pump Motor Installation.

ticular pump, the deck officer gives the signal to the operator in the engine-room. Pumps are thus under direct control at all times by the engineer on watch.

Since the La Brea went into commission she has handled over 500,000 barrels of oil, and in each case the discharge was completed with a material saving in time as compared with vessels with ordinary pumping system.

The capacity of the pumping system is of course, regulated by the capacity of the discharge lines and the pressure that the pumps are subject to. On a low-discharge head, and with ample shore connections the entire cargo could be discharged in approximately 10 hours' time. The maximum quantity of oil handled per hour against a pressure of 110 pounds per square inch is reported to be 4200 barrels.

The economy in fuel saved with this pumping installation appears to be approximately 45 per cent over the ordinary manner of discharging a liquid cargo.

After it was determined to use this system of pumping, with a pump in each individual tank, the most logical way of driving the pumps was by independent electric motors. In determining the proper type of motor, several propositions were considered. Inasmuch as the drive of the pump was vertical, both vertical and horizontal motors were considered. Twenty-five cycle would have permitted using a slow-speed vertical motor suitable for direct connection to pump without any gearing, but this necessitated the installation of special 25-cycle turbine generating sets. The higher speed of 60-cycle motors required connection to pump through vertical gears if vertical motors were used, and this was not considered practical. The horizontal motors, whether 60 or 25-cycle, required the use of bevel gears. All the power companies operating on the Pacific Coast and the various refining and loading stations of the Union Oil Company use 60-cycle, and the installation of 60-cycle motors had the advantage of being able to use shore power to drive the cargo pumps if required. For this reason, and also on account of long shipments required for the vertical 25 or 60-cycle motors, it was decided to use the horizontal 60-cycle type.

Work had been progressing very rapidly on the hull construction, but the motors and generating apparatus could not be ordered until after the amount of power required to operate the pump had been determined. An experimental pumping plant was installed, and it was some time before the data were available, with the result that shipment became very important and was the deciding factor why certain types of motors, etc., were selected. The cargo motors are installed, as previously stated, on the main deck, exposed to weather conditions and salt water, and so it was decided to use the open type and to enclose same in a water-tight casing supplied by the builder.

Ordinarily the pumps and motors would be required to start up against line pressure, and this would necessitate a high-starting torque slip-ring motor with its necessary starting resistance and controller. With this type of motor there is sparking at the collector rings and the controller fingers, and, as the motors would be installed on deck where explosive gases might be present, it was not considered practicable to use the same; consequently it was decided to use the ordinary squirrel-cage type. This motor, however, does not have torque sufficient to start a pump against full line pressure, and it was necessary to install a bypass on the cargo pumps. Pumps are brought up to full speed with the bypass open, which is gradually closed, at the same time opening up the valve in the discharge line.

As already stated, there are twenty-two of these cargo pumps, and each is equipped with a motor of the following rating: 40 h.p., 600 r.p.m., 3-phase, 60-

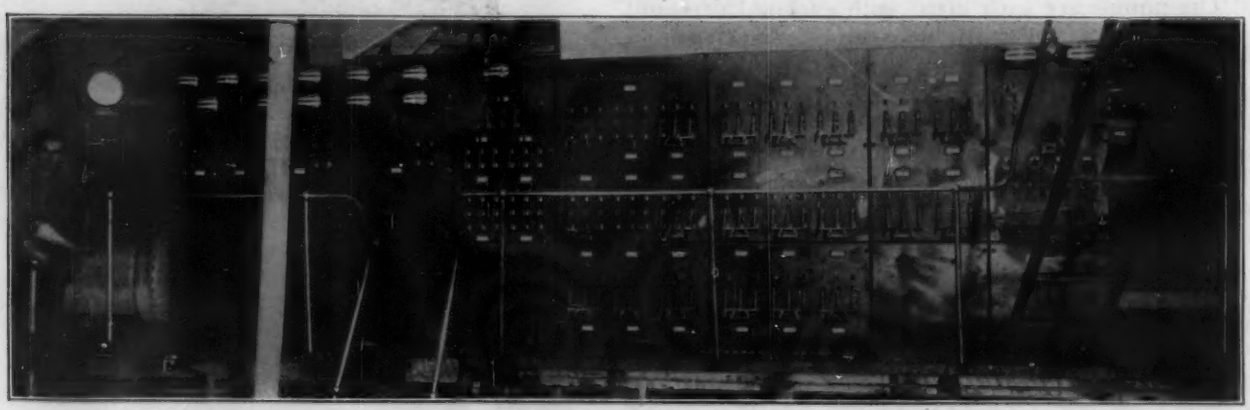

Fig. 7. Switchboard.

cycle, 220-volt, horizontal, squirrel-cage of the open type construction.

The motors are enclosed in a water-tight casing, as stated above, and this was made of cast iron. When loaded it is necessary for the motors to have proper ventilation, and the enclosing case is equipped with several hand-hole covers, which are opened when the motor is in service (Fig. 10). The motors ordered for the next installation are exactly the same, except they are enclosed and no additional water-tight casing will be required.

In addition to the cargo pump motors, the following motors were installed in the engine-room, depending on the same power plant:

One 60 h.p., 720 r.p.m., 3-phase, 60-cycle, 220-volt, horizontal open-type motor, direct connected to circulating pump for main condenser.

One 35-h.p., 1800 r.p.m., 3-phase, 60-cycle, 220-volt, motor, direct connected to one boiler feed centrifugal pump.

One 36-h.p., 1800 r.p.m., 3-phase, 60-cycle, 220-volt, motor, direct connected to centrifugal ballast pump.

The power plant is located on a gallery over the thrust shaft at the after end of the engine room and consists of two turbo-generating sets.

One 375 k.v.a., and one 125 k.v.a., 3600 r.p.m., 3-phase, 60-cycle, 240-volt, generators, direct connected to General Electric Curtis condensing turbines, with direct connected exciter.

These turbines exhaust into the auxiliary condenser, but it is also arranged so that they can exhaust into the main condenser. While discharging, the larger turbine is of sufficient size to operate nine pumps at about 140 lb. pressure, and for general purposes this is the maximum number of pumps that can be operated at one time with present shore discharge lines. However, necessary arrangements are made to operate both generators in parallel, making a total capacity of 500 k.v.a.; this would permit the operation of eleven to twelve pumps at the same pressure. In case of any trouble with the large turbine, the smaller unit could be used to operate two to three of the cargo pumps. When at sea, the 125 k.v.a. turbine is used, exhausting into the main condenser; this turbine is of sufficient size to operate the boiler feed, main circulating pump and lights. In case of any trouble with the 125 k.v.a. turbine, the larger turbine could be used. With the above arrangement there is always one turbine available as a spare.

For furnishing lights, there are supplied two transformers stepping voltage down from 240 to 120. To furnish the necessary power for the lights when both the above turbines are shut down, there is a small 5-kilowatt, 125-volt engine driven, direct connected generator available.

The switchboard is shown in Fig. 7, and is installed on a gallery on the starboard side of the engine-room. Starting from left to right, the switchboard consists of the following:

One swinging bracket, one synchronizing device, used for paralleling the two turbines and the voltage regulator.

Panel 1 controls the two direct connected exciters of the turbine sets.

Panel 2 controls the 125 k.v.a. generator set.

Panel 3 controls the 375 k.v.a. turbine set.

Panel 4 controls the feeder lines to the motors in the engine room and the compensators used for starting the cargo pump motors.

Panels 5, 6 and 7, control the twenty-two circuits to the cargo pump motors.

Panel 8 is the lighting panel and controls the five kilowatt generating set and the auto transformers which change the voltage from 240 to 110. It is so arranged that lights can be operated either from the main generating sets or the small auxiliary five kilowatt set.

One of the novel features in connection with this installation, and which is part of the switchboard, is the method of starting the cargo pumps. Ordinarily, the practice is to use a starting compensator with each squirrel-cage motor. For various reasons it was not considered advisable to use any starting devices where the circuit would be made or broken on the upper deck, on account of possible presence of explosive gases, and a scheme was worked out by which all the motors were started from the engine room switchboard.

Arrangements were also made to start all motors from two compensators, one of which is a spare. This is accomplished as follows: The three panels, 5, 6 and 7, controlling the cargo pump motors, have running and starting buses, the running bus energized direct from the generators, and the starting bus through the compensators. The starting bus is not energized until the contactor at bottom of panel 4 is closed. The switches starting the motors are triple pole, double throw. The upper contacts are connected to the starting bus and the lower contacts to the running bus. When the switch is thrown into the upper position, the blades engage the contacts, but no power is available until the switch is pushed all the way in, which closes a small auxiliary contact, which in turn closes the main contactor on bottom of panel 4. This in turn energizes the starting bus through the compensators and the motors start. An ammeter is installed in the starting circuit, which indicates when the motor is up to speed. When the motor is up to speed the motor switch is thrown into the lower position—that is, on the running bus—and the motor is then operating on full voltage. When throwing the motor switch from the upper to lower position, the auxiliary contact is the first to open, which in turn opens the main contactor, with the result that the making and breaking of the starting current is made on the main contactor. Each motor circuit is supplied with three fuses, installed on rack back of the switchboard to protect the motors from overload.

In order that the searchlight could be operated from the main alternating current generators or the five kilowatt direct current auxiliary generator, the direct current mechanism was removed from the searchlight and replaced with a high power concentrated filament incandescent lamp. This was tried out and worked very satisfactorily.

The data from logs on voyages to date, for the La Brea and Los Angeles give a general idea of the com-

parative performances of the two vessels and their equipment. The methods employed by companies in measuring oil into and out of a vessel sufficiently guarantee the accuracy of these data for general comparison.

Comparing the time in port discharging, and barrels of oil discharged per hour for the first six voyages, the La Brea was in port 36.4 per cent less time and discharged 55.4 per cent more oil per hour than the Los Angeles. If we reverse the order, it will be noted that the Los Angeles was in port 57.90 per cent more time and discharged 35.67 per cent less oil per hour than the La Brea.

In one case where the destination in each case was Antofagasta, Chili, and the Los Angeles preceded the La Brea by two days, notwithstanding the La Brea had been out of dock a month longer than the Los Angeles and a greater time in warm water, it is stated that she could have overhauled the Los Angeles and discharged first had the contrary not been arranged.

The La Brea consumed 17.09 per cent less fuel steaming, 42.47 per cent less fuel in port, 44.92 per cent less time in discharging, 17.43 per cent less fuel per knot steaming, 17.92 per cent less fuel per knot steaming and in port, and discharged 83.65 per cent more barrels of oil per hour.

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Many a "live" prospect has been killed by a "dead" salesman.

Business is the science of Human Service.

There are more opportunities today than there are men.

Society's problem: The High Cost of Loafing.

Don't make excuses—make good.

Some salesmen spend more time in hoping for orders than in working for them.

The successful man is the one who does a thing while the other fellows are holding committee meetings deciding whether or not to do it.

Success doesn't mean getting ahead of competition so much as getting ahead of yourself.

A smile is more contagious than a scowl—and much better for those around you.

Standing still is only death in another form. Trying to save funeral expenses is about the only excuse some people have for living.

And finally, work wins; you can't beat it!

—Norval Hawkins, in Manufacturers' News.

SHIPBUILDING ACTIVE ON THE PACIFIC COAST.

There is great activity in shipbuilding on the Pacific Coast. At the present time steel and wooden ships are being built on the Willamette and Columbia rivers which will cost more than $22,000,000. Oregon is peculiarly equipped with material for wooden ships, its timber being sent all over the world for this purpose. Shipbuilding operations of large proportions are under way at practically every port on the Coast.

WATERPOWER'S PRESENT STATUS.

(This summary of the facts leading to the present deadlock in waterpower development both on navigable streams and on the public lands, has been summarized from literature issued by the Waterpower Development Association of Washington, D. C. In brief compass it reviews the salient features of the deplorable situation which Congress is expected to relieve at its next session.—The Editor.)

Approximately 6,000,000 h.p. of hydro-electricity has been developed in the United States. The U. S. Geological Survey estimates that about 60,000,000 h.p. remains undeveloped. It is estimated that perhaps 15,000,000 of this undeveloped water power could in the near future be economically and profitably developed and used if the laws permitted. Water power cannot be utilized to advantage excepting where it can be generated and delivered at a lower cost than fuel power. The cost of installing water power plants is generally from two to three times that of installing steam plants and the interest on this additional investment in many instances amounts to more than the cost of fuel and operation in steam plants. In many sections of the country steam power is cheaper than water power because of this larger interest cost.

There are a number of large water powers undeveloped in the United States, the use of which is controlled by the federal government, at which hydro-electricity could be generated at very low cost. There is demand for this low priced power for many uses to which cheap power is essential. Electro-chemical industries, including plants for the fixation of atmospheric nitrogen, extensively used in manufacture of explosives and fertilizers; electro-metallurgical establishments, such as electric furnaces for reduction of ores and manufacture of electric steel; electrification of railway main lines; irrigation of arid lands by pumping systems, etc., all these are dependent upon very cheap power. The only power that can be developed cheaply enough to make such uses profitable is water power and the only water powers which can be developed cheaply enough to use to advantage for these purposes are now debarred from use by the inapplicability of existing federal laws.

Practically all of the power sites in private ownership that have a present development value have been developed. About 85 per cent of the undeveloped water powers in the United States are under control of the federal government. These powers include practically all of the possible large developments. The water powers under federal control divide into two groups:

1. Water powers on navigable streams.

2. Water powers on non-navigable streams in the public domain.

The United States does not claim to own any of the flowing waters which comprise either of these groups of potential energy.

Power Developments on Navigable Streams.

In the navigable streams the waters and the river beds are owned either by the states or by private riparian owners. The only control Congress has asserted over these streams is the power to regulate their use for purposes of navigation. That is, the govern-

ment cannot and does not propose to sell or lease or give away the waters in these streams, or the beds of the rivers. Congress has claimed no right or power to regulate or allow power developments in such streams except as these power developments may have a relation to the navigability of the waterways.

Very early in the history of the country the right of the United States to prevent or to permit and regulate obstructions in navigable streams was settled by the Supreme Court in an opinion by Chief Justice Marshall (Wilson vs. Black Bird Creek March Co., 2 Pet. page 245, 249 to 252). This power, however, was not exercised with regard to dams until 1890. Up to that time dams were commonly built under state laws. In 1890 national authority over the erection of dams in navigable streams was asserted in two sections of the Rivers and Harbors Act and for several years thereafter Congress from time to time passed special acts permitting construction of a few dams across navigable streams.

The first general dam act was passed in 1906. This act laid down certain general regulations to apply to all dams subsequently authorized by Congress, but Congress retained the sole authority to grant the permit in each case. In the first session of the Congress following its passage about twenty special acts were passed. In the ensuing year three such acts were passed, but the dispute over terms had already been resumed. An act authorizing a dam in Rainey River, Minnesota, under the provisions of the general act, was vetoed by the President and passed by Congress over his veto. This was immediately followed by the veto of a bill for a dam in James River, Missouri, which put a stop to the passage of enabling acts under the general act of 1906, excepting for one act passed in 1909 extending the time for the completion of a development in the Rock River in Illinois.

Following the Presidential vetoes of 1908 the question of general dam legislation aroused much interest and discussion and resulted in several amendments to the general dam act which were approved June 23, 1910. The amended act, however, while again intended to provide general laws governing all dams, still retained in Congress the sole authority to issue the permit in each separate case. The 1910 act was not even as effective in securing uniformity and development and quieting controversy as had been the act of 1906, and its provisions were even more burdensome to waterpower enterprise. Nevertheless, numerous applications were made to Congress for permits under the act and fourteen bills were passed, chiefly extending the time for the beginning or completion of projects already authorized. One omnibus dam bill providing for fourteen dams was passed by both Houses but died in conference, it being understood that if it was passed the President would veto it. The Coosa River dam bill, authorizing the construction of a dam in Alabama under the provisions of the general act of 1910, and without any additional requirements, was passed by both Houses in 1912, but was vetoed by the President. This ended all attempts to secure from Congress authority for dams under the act of 1910. Since this veto no enabling acts whatever have been passed authorizing dams in navigable rivers.

Under the act of 1906 twenty-five subsequent enabling acts were passed. Under these enabling acts only six plants have been constructed, and the remainder of the permits have lapsed under the time limitations, presumably because the projectors could not finance under the terms of the act. Activity in water power development throughout the country has increased enormously since 1910, but under the present law, passed in that year, the applications for permits to construct dams on navigable streams have been less in number than they were from 1906 to 1910. Under the 1910 act Congress has passed only fourteen enabling acts, and only two power plants have been constructed under them. Reducing the thing to percentages, the percentage constructed under the act of 1906 was twenty-four, while that under the act of 1910 has been fourteen. Two of the plants referred to as having been constructed under the act of 1906 were made financially possible because, in one case, of a very large and unusually profitable market which surrounds the risk; and, in the second, of the fact that the plant was but a small adjunct to a large power system held in fee, and the fee properties were made a lien under the bonds, the company being placed in a position where it had to have more power or acknowledge its failure to supply its customers. The total capacity of the plants constructed under the acts of 1906 and 1910 is less than 140,000 h.p.

The Pending Waterpower Bills.

Two bills dealing with water powers on navigable streams were introduced before Congress at its last session. The Shields bill passed the Senate and the House Committee on Interstate and Foreign Relations reported the Adamson bill as a substitute measure. The provisions of these bills have been thoroughly ventilated in these columns and as there was such a wide difference in them, they were referred to a joint conference committee of both branches of Congress for report to the next session.

Power Sites in the Public Domain.

In the public land states of the West there are many undeveloped water powers on non-navigable streams. Congress has no control over the waters in these streams, nor their use. These waters are under state control, and nobody can use them except by complying with the state laws. No permit or consent is necessary from the federal government to erect dams in these streams. The only control possessed by the federal government over these water powers lies in the fact that it owns much of the land in this part of the country, and where all or part of the land needed for a dam abutment, for a power house site, for overflow by a storage reservoir, or as a right of way for a transmission line, is within a national forest, national park, national monument, or elsewhere in the public domain, the power company which plans the development must buy or lease from the government the lands needed for the purposes enumerated. In former years there was little or no trouble about this. It was considered that the control of the water was the important consideration in developing water power, and that the acquiring and use of the land was merely incidental. At the outset of the conservation agitation a number of

years ago, however, all remaining undeveloped power sites on the public lands were withdrawn from entry under existing laws, and have remained withdrawn and locked out of use, awaiting the enactment of legislation that would permit of their disposal and use.

The only law under which the use of such power sites, rights of way, etc., can now be secured, is the act of February 15, 1901, which allows the Secretary of Agriculture to grant permits for use of power sites in the national forests, and the Secretary of the Interior to grant similar permits for use of sites in the national parks and other parts of the public domain. Permits so granted are revocable in the discretion of the secretary of the department by which they are issued. A number of developments were begun under such permits, in the belief on the part of power companies that the government would never revoke these grants. In 1909, however, James R. Garfield, then Secretary of the Interior, revoked twenty-five of these permits two days before he went out of office, without notice of hearing, jeopardizing millions of dollars which had been invested in good faith in these undertakings. Since then no waterpower developments of any magnitude have been made under this form of permit. A comparatively few small plants have been built in the national forests, but it has been impossible to finance projects for the development of any large powers that would provide the cheap electricity needed for the establishment of new electro-chemical and electro-metallurgical industries, the electrification of trunk line railways, irrigation of arid lands by pumping, etc.

In the last eight or nine years a number of measures have been introduced in Congress for the purpose of permitting these power sites to be occupied under conditions which would make their financing and construction possible. One group in Congress has insisted on terms so restrictive as to be unworkable, while another group has insisted that the United States should urn over all power sites and other public lands and resources to the individual states without restriction, and between these two schools of extremists it has been impossible to pass any legislation. In the meanwhile water power construction has come practically to a standstill and capitalists willing to invest money in great developments and new industries that would give the country the benefit of new scientific inventions and processes, have been compelled to stand aside, helpless to do anything, because it has not been safe to invest the hundreds of millions necessary for such developments under present federal laws, and the states have no authority to permit use of the power sites.

The Ferris bill for leasing power sites in the public domain was passed by the House of Representatives and the Myers bill was introduced as a substitute measuse in the Senate. These bills are now in the hands of the conference committee.

It is a consumation devoutly to be wished that as a result of these controversies that Congress will pass bills giving this greatly needed relief. The industrial development of the West particularly has been greatly retarded because of the lack of legislation giving investors confidence in the security of their investment.

AN ANTI-STRIKE PLAN OUTLINED.

The Merchants' Association of New York has sent to other commercial organizations throughout the country copies of a pamphlet containing the resolutions adopted by the association in support of the plan for preventing the interruption, by strikes, of the operation of public utilities, together with an outline by Henry R. Towne, of New York, telling how the plan might be carried into effect.

Briefly, it provides for the enforcement of a contractual relation between employers and employes on public utilities. It is suggested not so much as a final solution of this important question, although the Merchants' Association hopes it may prove to be such a solution, but as a means of bringing the matter forward for discussion. The Association has asked the Chamber of Commerce of the United States to submit the question to its constituent members in the form of a referendum in order that the sentiment of the business men of the country may be ascertained. It has also asked other organizations to join in requesting such a referendum.

The Merchants' Association has declared in favor of giving the federal government, through the Interstate Commerce Commission, control over railroad rates and regulation within state limits. This would do away with a large number of vexatious matters arising from the conflict between federal and state authorities over lines of transportation. The Merchants' Association is in favor of the federal incorporation of railroads; federal supervision of the issue of securities by interstate carriers; the enlargement of the Interstate Commerce Commission so as to enable it promptly and adequately to perform its functions; and strongly opposes government ownership of public utilities.

THE COST OF COAL.

At the recent American Mining Congress which met at Chicago, George Otis Smith and C. E. Lesher presented facts of vital interest to power men the country over on the subject of the cost of coal. The authors advocate the interstate regulation of the cost price of the commodity.

As coal is more an interstate than intrastate commodity, any regulation of prices needs to be under Federal control, and to benefit both consumer and producer such control cannot stop with transportation and mining costs but must stand ready to exercise full rights as a trustee of the people over the coal in the ground.

Public regulation, however, will be fair and indeed in the long run will prove beneficial to the landowner as well as to the consumer, to the mine worker as well as to the operator, because any such agency as the Federal Trade Commission, in its control of prices, must determine costs; and as we interpret the present attitude of the whole coal-mining industry, the operators are willing to rest their case on a fair determination of actual costs on which their profits may then be figured.

ELECTRIC COOKING.

BY. E. A. WILCOX.

The March of Progress.—Modern civilization's advance may be clearly indicated by the progress in methods of cooking. Wood was the first material to be used as a fuel. Water was boiled in a kettle suspended over a log fire and meats were broiled on a spit, or roasted in the embers, for many hundreds of years. When it was found that coal produced a more uniform and hotter fire, and was far more desirable than wood, another era of progress was marked. The old fashioned fire place gave way to the more modern kitchen range. Then came fuel gas, which may be considered a product of coal, and the gas stove made its appearance. Although the use of gas obviously involved more danger and was somewhat more expensive, it was found to be quicker and far more convenient.

Crowning success was achieved, however, when the electric method was perfected, and the bridging of space between the historic fuel fire and the modern heat produced without flame was accomplished.

Advantages of Electric Cooking.—The extent of the improvement brought about by the electric range is almost unbelievable. The heat is under absolute control. The operator knows and commands the temperature at all times. The wasting of heat has been reduced to a minimum. The units or burners generate the heat right where it is used, and very little loss takes place. The heat utilized in the oven is generated on the inside, and as its walls are heavily insulated with material of low thermal conductivity, there is practically no opportunity for useful energy to escape.

Facility of Operation.—The electric range is easier to operate and can be regulated with a much greater degree of accuracy and certainty than the fuel range. Being clean, safe and labor-saving, its use promotes greater cleanliness and comfort. It produces no excess heat, smoke or fumes to vitiate the atmosphere, and does away with the constant attention and anxiety of the fuel fire. Cooking utensils, furthermore, may always be kept clean and free from smoke and soot on both the inside and outside.

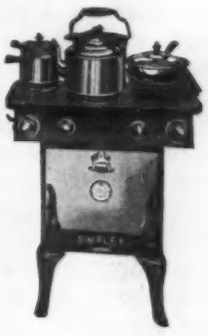
Uniformity is attained in the electric range because it will always produce the same results under the same operating conditions. For instance, the oven has to be opened but twice for each operation—once when the food is inserted, and again when the cooking is completed. The operator has only to watch the clock while the food is cooking. This advantage partially removes the objection that many persons have to a low oven, which, with fuel stoves, requires constant bending over to examine the condition of the food. Any housewife, of even moderate intelligence, should be able to master the essential features of the operation of an electric range in a short time by simply reading the card of instructions that is sent out by the manufacturers with each range.

Special Advantages.—The individual operations in oven, insures even baking and browning. It will bake bread, cake, and pies that are most attractive in appearance. They will always have just the right color, will contain more nourishment, and remain fresh longer. Roasts should always be prepared in an open which the electric range outclasses every known type of fuel stove, are baking, roasting and broiling. The heat being uniformly distributed in all parts of the

Hughes No. 60 Range (for Large Family Use).

pan containing no moisture, and basting is unnecessary in the electric oven. Sufficient moisture and meat greases will collect in the pan during the operation to prevent burning, and to provide material for gravy. The roast itself will come out of the oven uniformly browned on top, bottom and sides, if no basting is done. In both roasting and broiling operations the meat is seared, thereby retaining its natural juices, and making it more delicious, nutritious and attractive to serve.

Model G Hot Point Range.



Simplex 5-K Range.

Reduction in Meat Shrinkage.—Many experiments have been made in actual practice to show that there is less shrinkage in meats prepared electrically than by any other means. The meats sear over as soon as placed in the oven; there is no burning away of the fats and juices; and a saving of from 15 per cent to 18 per cent in the actual weights of the meats is effected. The tremendous economy in household expense that is made possible by the use of the electric range is apparent if we consider a family whose meat bill has averaged $15 per month and a saving made of 15 per cent in the meat shrinkage by the use of electricity. Meat costs in this family would be reduced $2.25 per month with the exercise of no additional self denial.

Assume an eight pound roast is placed in a 1600

watt electric oven and roasted 2½ hours. The current consumption at high heat would be 4 kilowatt hours, but by proper manipulation of the oven switch not over half this amount, or 2 kilowatt hours, would be actually consumed. The saving in weight of the meat over gas or coal cooking would amount to at least one pound. With current costing three cents per kilowatt hour and meat twenty cents per pound the actual saving to the housewife in cooking the roast electrically would be as follows:

1 lb. of meat saved at 20c	$ .20
2 kw-hr at 3c cost	.06
Actual saving	$0.14

Important to Use Proper Utensils.—Only flat bottomed utensils should be used for surface cooking on the electric range. Air is a poor conductor of heat, and consequently, the closer the heating unit can be brought to the bottom of the utensil, the greater will be the efficiency of operation. The necessity is particularly apparent in ranges making use of an element of the enclosed type, where the heat is transmitted to the food from a hot surface through the bottom of a utensil. If direct metallic contact is not secured the efficiency will be tremendously impaired; slow operation will result; and the housewife will become displeased.

Agate or enameled ware should never be used on enclosed type elements. Iron, copper, or aluminum vessels will be found far more efficient. On the other hand, agate, enameled ware, and black bottomed iron utensils have been found very satisfactory for use with open type elements. Polished metallic bottom surfaces reflect and do not take up the heat from a radiant type element as do black surfaces. Contrarywise, highly polished sides and tops retain heat in a utensil much more efficiently than do dark or rough surfaces. If the bottom of any kind of utensil is corrugated, hollowed out or warped it cannot be expected to give satisfactory results.

Economy in Range Operation.—Food prepared on the cooking surface will not burn on the inside of the utensil as long as any moisture remains in the vessel, because heat is applied only at the bottom and never at the sides. For this reason, the amount of water usually required to keep food from burning may be reduced and the operations performed more easily and quickly. The food will be steamed thoroughly, and the natural sweetness and flavor will be cooked into the food, rather than boiled out into the water poured away. Water absorbs more heat than any commonly known substance, and a little economy in the use of water will effect considerable saving in both heat and electricity.

Users of electric ranges should be encouraged to use water drawn from the hot water storage supply for cooking purposes. Water taken from the top of a tank is obviously purer than that taken from the water mains because the tank acts as a natural settling basin for the collection of all impurities and sediment. If hot water is used in preparing foods, the operations may be done more quickly, and considerable saving in current consumption effected.

One very common method of effecting economies in the operation of a range, is to place as many foods as possible in the oven instead of on the cooking surface. The oven, being heavily insulated, retains practically all the heat generated and the usual losses that attend cooking on the surface units are thereby done away with.

Water for laundry work, washing, bathing, and other domestic purposes cannot be heated as economically on an electric range surface as by other means. If the housewife desires, however, she may successfully boil clothes by placing an ordinary copper bottom boiler over two of the range discs. Quicker action will result if the boiler is kept covered, and a heavy paper wrapped about the sides of the vessel.

Hughes Junior Range (for Early Training of Housewife).

The saving that may be effected by skilful use of the individual three-heat switches is often little understood by the average woman. She should be trained to know that the low heat consumes but one-quarter, and the medium heat one-half as much current, as the high heat. Food brought to the boiling point on high heat should be retained at this temperature at low or medium heat. A boiling temperature higher than 212 degrees F. cannot be obtained in an open vessel and food will cook just as quickly when boiling slowly as when boiling rapidly.

THE NATIONAL ELECTRICAL SAFETY CODE.

The National Electrical Safety Code of the Bureau of Standards in its second edition comprises, under the first three parts, a proposed national standard for safe construction and installation of electrical supply equipment in stations, of electrical transmission, distribution, and signal lines, and of the electrical utilization equipment of factories, offices and homes. It also includes as part four a set of safety rules to be observed in work upon electrical equipment and lines. The rules have been submitted to much careful study, to discussion at many conferences, and to wide criticism through correspondence, since the first edition published April 29, 1915, and which was marked "Preliminary Edition—Submitted for Discussion and Criticism—Not for Adoption."

SPARKS—CURRENT FACTS, FIGURES AND FANCY

Eighty-four oil tankers are under construction in American shipyards. The total gross tonnage of these ships is over a half million.

* * *

Dangers to transportation through European waters and the Suez canal during 1915 resulted in turning to California a half million dollars of the American trade with British India.

* * *

One of the commendable accomplishments of the recent convention of the National Safety Council at Detroit was the adoption of a universal danger symbol —a red ball on a white Maltese cross with a black background.

* * *

The United States for the first time in her history ranked first in exports from and imports into Chile during 1915, receiving more than forty-two per cent of Chilean exports and selling to Chile more than thirty-three per cent of the goods imported.

* * *

Even the gas bus has appeared as a jitney. In England a jitney bus is being operated over a twelve mile run by having installed above its passenger compartment a huge rubber-lined gas bag that contains four hundred fifty feet of gas for operating purposes.

* * *

The operation of a plan so minute in its detail as to cover the individual visitation of every one of the nineteen thousand Jovians in America within a month is now in full swing. The resulting enthusiasm and renewed interest engendered will be watched by all well-wishers of the order.

* * *

Fear of the Sherman anti-trust act is a valid reason for breaking a contract, according to a decision recently by the United States Circuit Court of Appeals at San Francisco, Cal., in the case of the Davenport Independent Telephone Company of Washington against the Pacific Telephone & Telegraph Company.

* * *

The one-man car which found its initial installation in Missoula, Montana, some years back, still continues to find a useful and economic field of application. The Tacoma Railway & Power Company of Tacoma, Wash., is rebuilding six double end, single truck closed cars and equipping them for one-man operation.

* * *

The latest effort leading to scientific efficiency has just been inaugurated by the University of California which offers to send to any community of the state upon request, a woman field agent to show how farm work may be made easier and pleasanter by new labor saving methods. In these methods electrical appliances play the leading role.

The possibility of producing pig iron in New Zealand on a large scale is being thoroughly studied by the authorities as well as by private interests here. It is proposed to use electricity for this purpose instead of coal, as indicated in a circular containing the report of the chief electrical engineer of the New Zealand government.

* * *

Within the past few weeks the season of daylight saving, wherever it has been tried, has come to an end, and the clocks have gone back to their normal standing. As to whether the psychologic effect of fooling oneself into believing that an hour movement ahead in a time piece is sufficient in itself to energize the human makeup to fuller effort is still a debatable question.

* * *

When Goodyear, the inventor of rubber, showed the world how a little sulphur would help vulcanize the gumming mass of pure para, he little thought of the thousand and one applications his discovery would have. From the simple desire to provide the oilskins in use by the mariners of merry Old England with a covering that would not dry out or crack, has grown an industry that enters nearly every phase of modern life, among the extremes of which may be mentioned the office packet rubber and the automobile tire.

* * *

Nitrate deposits in many parts of the United States have been examined during the last two years by the United States Geological Survey, Department of the Interior. The importance of finding a natural supply of nitrates within our own borders, which might serve our needs in case of war, has given incentive to this work and has directed widespread public attention to the subject. According to the press bulletin of the Department of the Interior the investigation has proved disappointing. Once again the gaze turns toward hydroelectric development for manufacture of nitrates.

* * *

The Virginia Railway & Power Company has taken steps to provide an absolute safety stop at railway grade crossings. Should the motorman in approaching the grade crossing not heed the proper signals to bring his car to a stop, so that the crossing may be properly flagged, the spring contact on top of the car engages an inverted channel, which is energized, thereby energizing the magnet of an electropneumatic valve. This valve sands the track, cuts off the current and brings the car to an emergency stop. It is then necessary for the conductor or motorman to alight from the car and reset the valve before the car can proceed as he cannot restore the power to the car or release his brakes until this is done.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Forward

Hitherto engineers of the eight Pacific Coast states have prided themselves upon the fact that while the population of this section of our country is but six per cent of the total, yet within its confines are to be found more than one-third of the hydroelectric power developed in the United States. This investment in central station construction and equipment, exclusive of combined electric railway and power companies, represents an outlay of over six hundred million dollars.

With the new year in sight the outlook for the future is most encouraging. A sense of confidence and expectancy is felt by all. Never before in the history of the West have her financial institutions been on a more solid footing, her agricultural production more sought for in the open markets of the world or her mines and other natural resources been developed and operated to such a maximum of effort.

With this inward feeling of security and confidence for the future has come a desire on the part of Western engineers to come in closer contact with their brother engineers in the countries bordering the Pacific. For years the golden traditions of California and the West have thrilled those who dwell in our neighboring countries of the Pacific and the doings and happening of each have closely been allied to the thought and progress of the other.

It is with an idea of cementing these golden ties which bind the countries bordering the Pacific and with a profound feeling of confidence in the business outlook for the immediate future, that the Journal of Electricity with the new year proposes to take a very ambitious move forward.

Beginning with the first day of January the Journal will be published thereafter on the first and fifteenth of each month as a semi-monthly. This new arrangement will allow its publishers to greatly diversify the editorial composition and vastly extend its present field of usefulness. A further detailed account of the new Journal and its ideals will be found on one of the advertising pages of this issue, where we have taken this means of advising our readers of the most important announcement we have yet made.

The new Journal will endeavor to enter not only the places of business for engineering and construction, but also the associated commercial houses of all onr neighboring countries of the Pacific. Plans are now under way to forward this object, announcement of which will be made at a later date.

As an instance of the growing commercial relationship with our Pacific Coast neighbors the case of the Republic of Chile to the south may be cited. In 1915 the United States for the first time in its history ranked first both in exports from and imports into Chile, receiving more than forty-two per cent of the goods imported. Machinery, machine tools, instruments, apparatus, industrial oils and fuel largely make up the imports of the United States into Chile.

But while commerce and engineering must largely be the material means of interchange with our neighbors, it is to be the purpose of the new Journal to interest itself vitally in the ethical standard of this interchange and in assisting in the standardization of engineering and commercial methods and mediums of exchange. It shall be its purpose to give to these countries ideas of engineering growth and expansion that represent the very best and truest of our Western ethics, but free from those factors that have in the past had a tendency to mar her wholesome growth. On the other hand the Journal hopes to bring to its present readers much of the newness of life and wholecomeness of business enterprise and activity that pervade our Pacific Coast neighbors.

The Journal feels that in this new move it has back of it the strong support and good wishes of all its readers, and with the fullest assurance and confidence of their continued support takes this forward move.

Taking the Appliance into the House

An unusual method of educating the housewife in labor-saving devices has been inaugurated during the past year by the agricultural extension division of a Western state university.

In California any group of neighbor women, any woman's club, or any community desiring a demonstration on how to make the farm household work easier and pleasanter by new labor-saving methods need only write to the state university and with no charge whatever a woman demonstrator is sent to fill the request.

The fundamental idea is to increase the scientific efficiency of the home and especially to show how the farm home may be made more livable and attractive and how the family may get more real enjoyment from life.

A map recently compiled by the university authorities showing where such women's farm home demonstrations have been held during the past year and one-half records one hundred and forty different demonstrations in twenty-eight California counties before more than seven thousand women.

It is needless to remark in passing that an ever increasing proportion of the labor saving devices exhibited are electrically operated.

It would seem that this method of demonstration is superior to any other. After all is said and done, the success or failure of an electric appliance or in fact of any other type of household labor saving device must eventually rise or fall upon the merits of each individual case. The actual trying out in the home is hence the final and crucial test.

The slow entrance of electrical labor saving appliances into the home is in most cases directly traceable to the fact that sufficient actual demonstration in the home is lacking. Often times the trial that is made is so biased in its setting that it lacks the conviction of the onlookers to create a desire to purchase and install in the home.

It would seem an excellent idea for those interested in the sale of electrical appliances to see to it that an ever increasing proportion of labor saving electrical appliances were at the service of Western universities and colleges in order that the rural communities may be properly educated and new fields for appliance sales thereby opened.

Splendid Outlook in Coast Shipbuilding

The ever widening applications of electrical energy in driving the wheels of industry and pushing forward the bounds of commerce were never more marked on the Pacific Coast than at this writing. For some time back engineers of the West have noted with growing satisfaction the splendid future for shipbuilding on the Pacific Coast. Today this industry has advanced to such proportions that the new work now under way in the various shipyards of this section of the country represent a very large percentage of the building at present undertaken in all the yards of the nation.

There are several factors that are accountable for this state of affairs, and among them is to be reckoned as by no means the least the fact that ingenuity and building methods are here to be found that not only favorably compare with that of other districts, but in several notable instances are proving to be superior.

Take, for instance, the recently completed oil tanker La Brea, a description of which is to be found on another page of this issue. Here the steam turbine drive and the electrically operated pump have distinctly won out in the operation of this boat in comparison with a sister ship operating under the triple-expansion steam drive formerly advocated as the more efficient.

By referring to the data compiled in this article it is seen that the turbine driven tanker was in port 36.4 per cent less time and discharged 55.4 per cent more oil per hour than its sister ship, which is operated under the triple-expansion, reciprocating steam drive. Indeed, in a recent trip to one of the ports of Chile, the latter boat preceded the former by two days and yet notwithstanding the fact that the turbine driven boat had been out of dock a month longer than the reciprocating engine drive and a greater time in warm water, it is stated that it could have discharged its cargo first had not the contrary been previously arranged.

The electrical operation of the oil pumps that control the loading and unloading features of the fleet of tankers to which the La Brea belongs is also a factor of considerable interest to engineers of the West.

Undoubtedly it will prove from time to time of great economic importance to operate these pumps by electrical energy purchased from local hydroelectric companies when these boats are in port where electrical energy may be contracted for. Thus this new development in tanker design is of great economic value to the central stations of the Coast.

Again, in countless other ways electrical applications and appliances are winning their way into modern shipbuilding design. Indeed, so much so that it may well be anticipated that the continued prosperity of the shipbuilding industry is of tremendous importance to the electrical activities of the Coast, and every means should be taken to further link the destinies of the one with the other.

PERSONALS

W. E. Hayes, of the Hayes & Van Fleet Electric Company of Santa Rosa, was a recent visitor at San Francisco.

Earl P. Durley, of the Rieber Laboratories has recently been appointed managing engineer of that company.

M. L. Joslyn, president of the Joslyn Supply Company of Chicago, has returned East after a short trip to Seattle.

Frank Somers, manager of the Century Electric Company of San Jose, spent a few days in San Francisco this week.

S. V. Walton, commercial manager Pacific Gas & Electric Company, has returned to San Francisco from a trip to Los Angeles.

L. F. Youdall, manager of the Electric Machinery & Equipment Company of Stockton, was at San Francisco during the past week.

G. W. Bernhard, district manager of the Great Western Power Company of Petaluma, was a recent business visitor at San Francisco.

C. F. Haller, of the Haller-Cunningham Company, has recently left for Chester, Pa., to install a wireless set on the steamship "Malmanger."

F. J. Airey, Los Angeles district manager of the Pacific States Electric Company, spent a few days on business at San Francisco this week.

C. V. Schneider, manager of the Electrical Supply Company of Sacramento, was a business visitor at San Francisco the first part of the week.

Wm. Crow, sales manager of the Rector System Gas Heating Company at San Francisco, has left for an extended trip throughout the Northwest.

C. B. Hall, treasurer and secretary of the Illinois Electric Company, will return to Los Angeles this week from the Westinghouse jobbers agents' meeting at Hot Springs, Va.

Wynn Meredith, of the firm of Sanderson & Porter, who has been superintending operations on the pipe lines being built in Oklahoma, will arrive at San Francisco December 20th.

H. S. Perkins, local manager of the J. H. Parker Company of Parkersburg, West Virginia, recently returned from an extended business trip throughout the East, where he visited his factory.

C. G. A. Baker, vice-president and treasurer of the Baker-Joslyn Company, returned to San Francisco the first of the week after a few weeks' business trip through Seattle and the Northwest.

Fred Myrtle, publicity manager for the Pacific Gas & Electric Company, formally threw the switch which tied in the new No. 4 hydroelectric plant with the rest of the system on November 25th.

W. C. Cole, of the Westinghouse Electric & Manufacturing Company, spent a few days at Marysville last week, and was present at the launching of the Yuba Construction Company's new dredge No. 16.

F. W. Gay, who recently opened offices as consulting engineer in the Alaska Commercial Building, San Francisco, has been appointed engineer by the Bankers Trust Company, holders of the underlying mortgage of the Mt. Whitney Power & Electric Company.

H. J. Verfurth, general manager of the Central California Electric Company at Lindsay, has left for an extended Eastern trip, where he will attend the meeting of the Willard Storage Battery Company at Toledo, Ohio, and make a tour of inspection of the manufacturing centers of the East.

L. S. Webber, formerly with the Turner Company of San Francisco, and **J. B. Kimber,** who were on the joint committee of telephone and power companies, to study the inductive interference set up by the high tension wire, have recently joined the engineering force of the Rieber Laboratory.

John W. Beckman, chemical engineer, has recently returned from the Second Annual National Exposition of Chemical Industries held in New York City under the auspices of the American Electro-Chemical Society. Mr. Beckman was the guest of the Oakland Kilowatt Klub on November 23d and gave an interesting address concerning Pacific Electrochemical possibilities.

Harris J. Ryan and **J. C. Clark,** of the electrical engineering faculty of Stanford University, proved themselves admirable hosts in the entertainment of the San Francisco A. I. E. E. Section which visited the Stanford University High Tension Laboratories on Saturday afternoon, November 25th. Interesting experiments were performed on insulators subjected to high voltage and high frequency strains, and instructive explanation was given covering the phenomena observed during the tests.

MEETING NOTICES.

San Francisco Section Institute of Radio Engineers.

A meeting on the evening of November 21st, was held at the Engineers' Club, San Francisco, by the local members of the Institute of Radio Engineers, for the purpose of organizing a local branch of the institute. The meeting was called to order by acting chairman W. W. Hanscom, after which V. Ford Greaves, radio engineer with the U. S. Department of Commerce, gave a short talk on the organization of the new branch and the benefit offered to the members by attending the meetings. Election of officers for the ensuing year followed, W. W. Hanscom being unanimously elected chairman, V. Ford Greaves, secretary-treasurer, and H. G. Aylsworth being elected the remaining member of the executive committee. George S. de Sousa, traffic manager of the Marconi Wireless Telegraph Company, read a copy of the new radio bill which has been drafted by the navy department to be presented before the next session of Congress. After discussion it appeared that the bill was not favored by the majority present and that it is not the right step to be taken towards the development and restrictions of radio work at the present time.

Los Angeles Jovian Electric League.

Edw. Woodbury of the Pacific Light & Power Corporation, was chairman of the day at the regular weekly luncheon on November 22d. H. L. Carnahan, commissioner of corporations of the state of California, was the guest of honor, and in an instructive and entertaining informal talk, told of the activities of the corporation department in the work of protecting the public through the law which requires all corporations, except public utilities, to obtain a permit from the department before treasury stock can be issued. He asserted that legitimate business is solidly behind the law, which went into operation January 2, 1915, and that through its operation, the prices of corporate securities have been raised, and also that a noticeable increase in savings accounts has occurred, and moreover, has reduced the number of enterprises of questionable character over 90 per cent. In closing he stated that the department is glad to assist and inform the public on all matters within its scope, i.e., that of building up legitimate business. Tribune Sessions announced the rejuvenation to be held at the Elks' Club, on December 8th, and through his efforts a large class of candidates has been secured.

Portland A. I. E. E. AND N. E. L. A. Meetings.

The joint local sections of the A. I. E. E. and N. E. L. A. had a special meeting in the main hall of the central library at Portland, Oregon, Thursday evening, November 23d.

Dr. Earl V. Morrow, recently from the staff of the Belgian hospital, gave an extremely interesting lecture on "Experiences in Belgium." His talk was illustrated with a num-

ber of lantern slides, taken by himself and with the consent of King Albert of Belgium.

Dr. Morrow had charge of the American Red Cross unit sent to Belgium, consisting of ten doctors and sixty nurses. His hospital was close to the first line trenches and handled only surgical cases. It contained 2200 beds. He told of the terrible sanitary conditions of the trenches, which were beyond description as the stench from the unburied dead, mud and rats combined to make this condition. He classed the various methods of destruction in the following manner as regards the one which causes the greatest destruction. Automatic guns, first, curtain fire next, 42 centimeter guns of the Germans, and aeroplane bombs and darts last.

San Francisco Electrical Development and Jovian League.

That the November 22d luncheon was the best attended of the present administration may be regarded as a tribute to Fred H. Leggett, chairman of the day, and N. J. Prendergast, chairman of the entertainment committee, who has recently been providing many high class features for the League meetings. The guests and speakers of the day were three distinguished Japanese gentlemen, Hon. Massanco Hanihara Consul General of Japan, Mr. K. K. Kawakami and J. G. Kasai, who gave an instructive address on Trade Relations Between Japan and the United States. Mr. Leggett, in introducing the speakers, said that "trade means contact, contact dispels misunderstanding, misunderstanding dispels disputes." Mr. Kasai traced the growth in trade between the United States since Commodore Perry's visit six years ago. He gave statistics as to the trade of today. Raw silk constitutes 85 per cent of the total imports from Japan. The chief exports from this country to Japan are cotton, kerosene and steel plates. The speaker reputed various jingo charges of discrimination, favoritism and menace. He briefly reviewed the present state of the electrical industry in Japan and made an earnest plea for strong commercial relations between the two countries. At the suggestion of President L. H. Newbert the guests and speakers were given a rising vote of thanks.

The Oregon Society of Engineers.

The Oregon Society of Engineers had their regular monthly meeting at the Rose City Club House, East 57th street and Sandy boulevard, Portland, Oregon, Thursday evening, November 23d. Capt. George S. Edmonstone gave a talk on the O. W. R. R. & N. regrade project. His talk was illustrated by lantern slides. The O. W. R. R. & N. regrade will cost about $600,000 and will consist of the lowering of the tracks of the railroad company from East 32d to East 92d street; building seven bridges over them, and constructing the proper approaches and other necessary works. J. C. Stevens, second vice-president of the society, was chairman of the evening. The attendance was fifty.

The regular bi-monthly meeting of the luncheon club of the local sections of the A. I. E. E. and the N. E. L. A. and the Oregon Society of Engineers was held in the orange room of the Oregon hotel at 12:15 p. m. November 22d..

Mr. O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, acted as chairman of the day. Mr. W. P. Hawley, Jr., of the Hawley Pulp & Paper Company, of Oregon City, was to have spoken on the "Application of Electricity in the Paper Industry," but on account of business was detained in Oregon City and could not attend.

Mr. E. F. Whitney of the General Electric Company, spoke in his place on the same subject. Mr. Whitney outlined the various interesting and unique points in regard to the adaptation of electricity to the special machines used in the manufacture of paper, such as the grinders, gordon machines, beaters and paper machines. Two prizes were given away, an electric toaster and a flashlight. The meeting was under the auspices of the Portland R., L. & P. Co. The attendance was seventy-two.

San Francisco Section A. I. E. E.

The regular monthly meeting was held at the Engineers' Club, November 24th, Chairman J. E. Woodbridge, presiding. The general subject was "Deterioration of Suspension Type Insulators," with an introductory paper by J. E. Woodbridge and J. P. Jollyman, a paper on methods of experiment by Professor J. C. Clark and a paper on ceramics by Professor Harris J. Ryan.

Mr. Woodbridge explained that the necessity for learning the causes of the failure of high tension insulators had induced several California power companies to subscribe to a fund for an exhaustive series of tests in the high tension laboratory at Stanford University during the summer of 1916. These tests demonstrated the fact that the trouble is due primarily to the porosity of the porcelain but as yet have suggested no satisfactory means for alleviating the difficulty. All porcelain was found to be more or less porous due to the fact that it cannot be liquefied in the process of manufacture. The experiments would seem to indicate that the most satisfactory substitute would be fused silica, which has high di-electric and mechanical strength.

Professor Clark described the apparatus employed to detect defective units with greater celerity and certainty than is obtainable with an ordinary megger. This apparatus consists essentially of an initial source of 25,000 volt current, transformers, kenetron, condenser, and galvanometer, together with guard rings to eliminate errors due to leakage. Several hundred units from six makers were tested. These tests showed that strain does not affect insulating properties, that with increased temperature there is a rapid decrease of resistance and that the presence of moisture lessens resistance. Many futile attempts were made to obtain a standard method of regulating the moisture content. A rough classification of insulators as slightly porous, porous and very porous is possible, but no satisfaction was obtained in coordinating insulation properties with moisture content.

Professor Ryan discussed the ceramics of the problem as regards durability, electrical strength, refractoriness, mechanical strength, design and cost. All these requirements are closely interrelated and porcelain is satisfactory in every respect except durability. He believes that there is too great a difference between acceptance tests and service tests. In his studies he has called into consultation the geologist, chemist, physicist and ceramist. The geologist advises that high durability is not to be expected in porous bodies. Dry process porcelain is consequently not serviceable because in the process of manufacture a porosity of 1 per cent is attainable with difficulty, whereas 1-10 per cent or less can be reached with wet process porcelain. Waterlogged porous porcelain becomes an electrolytic conductor in effect. Likewise the use of cement for attaching pins will eventually cause insulator trouble.

Professor Ryan presented a number of diagrams and abstracts from the transactions of the American Ceramic Society. These showed that the best electrical porcelain is obtained with a firing temperature of about 1355 degrees C. Overfired porcelain is brittle and mechanically unreliable while the underfired is porous. The porosity cannot be corrected by annealing or form of design. Porcelain with a high percentage of flint is less porous and this suggests that fused quartz would be suitable for insulators except for the difficulty in making it free from gas bubbles.

In the ensuing discussion J. A. Koontz stated that a slightly porous insulator may not become waterlogged for a number of years and thus give good service, but that it will eventually deteriorate with time. W. W. Hanscom suggested that the microscope should be useful in testing insulators, that porosity might be used by impregnation and that some liquid other than water might be better adapted to test purposes.

NEWS NOTES

INCORPORATIONS.

BOZEMAN, MONT.—The Gallatin Valley Gas Company, capitalized at $300,000, has filed articles of incorporation and has asked this place for a franchise.

YUMA, ARIZ.—Articles of incorporation have been filed by the Yuma Light, Gas & Water Company. The incorporators are: R. M. Moore, D. F. Hill and Frank V. Pfaffinger, all of Los Angeles, Cal. Capital is $200,000.

ILLUMINATION.

WILLCOX, ARIZ.—Before long the town will be lighted with electric lights.

OAKLAND, CAL.—City Engineer Goodwin is fixing the location of the new electroliers to be erected on East Fourteenth street.

CHICO, CAL.—The board of trustees has instructed City Engineer Martin Polk to draw plans and specifications for an electrolier system.

ROSEBURG, ORE.—The Miller Hill Electric Company of Portland has been awarded the electrical contract on Roseburg's $90,000 high school.

FRESNO, CAL.—The contract for the installation of an electrolier lighting system has been let to the Mt. Whitney Power & Electric Company for $2900.

MERCED, CAL.—Co-operation of the board of supervisors in the city scheme of installing an electrolier system has been assured by the county board.

LOS ANGELES, CAL.—Sealed bids will be received by the board of public service commissioners before December 8th for incandescent street lighting equipment, in accordance with specifications on file with the board.

MYRTLE CREEK, ORE.—Bids will be received by the town recorder, Chas. W. Rice, until December 5th, for the construction of a water and light plant, according to proposition No. 1 of the plans and specifications on file with the recorder.

ANAHEIM, CAL.—At a recent meeting of the board of trustees, W. A. Mattox, representing the Western Gas Engine Company, addressed the board in reference to furnishing the city with light. The board has taken the matter under consideration.

CARPENTERIA, CAL.—A committee of the chamber of commerce on electric lights is bringing the matter of street lighting to a focus as rapibly as possible and it is hoped that steps towards calling a special election may be taken before the first of the year.

SANTA BARBARA, CAL.—At an early date action will be taken toward creating a lighting district on State street and adopting plans and specifications. There will be 14 lights to the block between De la Guerra and Victora and 10 in the block on the boulevard.

POMONA, CAL.—It is reported that another whole section of the city lying between Alvarado and Hancon and San Antonio and Garey avenues, has been practically signed up for ornamental lights and the matter may soon be brought before the city council.

RENO, NEVADA.—The Gardnerville & Douglas County Milling & Power Company, which operates a large mill and lighting system at this place, will be enabled to make important extensions to its lighting system as soon as it completes its large storage dam.

BOISE, IDAHO.—The Shelley Light & Power Company has asked the public utilities for a certificate of convenience and necessity which would permit it to furnish the village of Shelley with electricity under the terms of a new franchise. The request has been granted by the commission.

HOLBROOK, ARIZ.—Sealed bids will be received until December 9th at the office of the chairman of trustees of Holbrook School District No. 3, for furnishing material and installing electric light wiring in Holbrook public school building now under construction.

SEATTLE, WASH.—A further step in the development of the light and power system of the city was made when an order was introduced by Councilman Erickson, providing for the construction of a steam electric power plant, adjoining the site of the present power plant on Lake Union, to cost about $390,000.

ROUNDUP, MONTANA.—Work on two additional ornamental lighting systems in Roundup has begun. One ornamental lighting system will be an extension of that now in operation in the business district, and the other will cover the entire west side residence section of the city. The latter will be of the one-light type, with steel posts set six to the block.

TRANSMISSION.

OREGON CITY, ORE.—Fire in the new power plant of the Hawley Pulp & Paper Company's mill damaged the new generator to the extent of $6000.

SAN FRANCISCO, CAL.—The Great Western Company has recently completed its high tension steel pole line between Valona and Vallejo, total distance of 14 miles, using 75 ft. steel poles.

MOGOLLON, N. M.—A representative of the state engineer's office has visited this place securing data and inspecting the proposed hydroelectric sites. This move augurs well for the early realization of adequate and cheaper power for the district.

OAKLAND, CAL.—The Key Route Station, known as the Yerba Buena Station of Oakland, has recently been converted from the old reciprocating type engine to a modern turbine type with a 7000 kw. load, by the Great Western Power Company.

YREKA, CAL.—The California-Oregon Power Company made a contract with the Fruit Growers' Supply Company at Hilt to furnish power for their mills. Preparatory to constructing the line from Hornbrook to Hilt, a survey is being made between these two towns.

RITZVILLE, WASH.—The Pacific Light & Power Company has made application to the board of county commissioners asking for a franchise to construct transmission lines for the purpose of conveying electricity over the roads of Adams County. A hearing will be held December 5.

SALT LAKE CITY, UTAH.—Extensive development of the Utah Power & Light Company, which already have taken place, and plans for future general development, have resulted in the increase of the capitalization of the company from $45,000,000 to $60,000,000, which was recently announced. It is reported that development will consist chiefly in extensions in furnishing power to railroads and electric furnaces of iron smelters.

SAN FRANCISCO, CAL.—Paul B. McKee, assistant to the president, accompanied by J. C. Thompson, assistant to the secretary, of the California-Oregon Power Company, have returned to San Francisco from a trip over the entire system. They state that construction is being started on a 7½ mile line from Hornbrook to Hilt, in Siskiyou County. They are using a ⅜ in. common galvanized guy cable for their line on account of the high cost of copper. The company is now in new offices at 129 Leidesdorff street.

BOISE, IDAHO.—Senator Dow Dunning of Owyhee County and John C. Rice, judge-elect to the state supreme

court, appeared before the state land board and asked for a contract between the state of Idaho and the Gem Irrigation District for $300,000. The contract would be taken before the legislature this winter and an effort made to get an appropriation for that amount with which to build a power plant at the Arrowrock dam for the purpose of furnishing the Gem district with electricity. The matter will be taken up again.

CHLORIDE, ARIZ.—The Desert Power & Water Company, after spending $50,000 to bring its line into Chloride is confronted with the possibility of having to uproot every improvement it makes in the confines of the camp. There is no alley or street that give assurance of being where it is now located after the townsite is surveyed and plotted. The sum of $4000 is being spent by the company in extending wire throughout the camp, and it is possible that all this will have to be done over in the near future.

TELEPHONE AND TELEGRAPH.

EVERETT, WASH.—A franchise for the construction of telephone lines in this vicinity has been granted to the People's Telephone Company.

BOISE, IDAHO.—The Arcadia Farmers' Telephone Company has been granted a certificate for the building of a telephone system to connect the community of Arcadia with the Mountain States line near Jerome.

SAND POINT, IDAHO.—Work will be commenced this week on the construction of 16 miles of government telephone line which will connect Moyie and Leonia. The line is being built under the supervision of J. A. Fitzwater.

REPUBLIC, WASH.—A plan is under way to incorporate a telephone line from Orient connecting points at Pierre Lake, Hungry Hill and Kelly Hill. The Pacific Telephone & Telegraph Company is abandoning its line between here and Bossburg.

OKANOGAN, WASH.—The commissioners have received application for a franchise from the Colville National Forest to construct telephone lines on roads leading to Chesaw, Molson, Oroville, Tonasket, Riverside, Havillah, Wauconda, Anaes, Angling and Leese.

LOS ANGELES, CAL.—At the suggestion of the city engineer the commission authorized agreements with the telephone companies for the joint use of their poles and went on record as opposed to any telephone merger unless the new company agrees to plan for the joint use of poles by the city and the company.

WILLCOX, ARIZ.—Parties representing the Mountain States Telephone Company have been here for several days looking over the property recently acquired by the company formerly the New State Telephone & Telegraph Company. They state that considerable improvements are under consideration, including replacing the present wiring with copper wires, new poles, etc.

LOS ANGELES, CAL.—Hearing on the petition of the Home Telephone Company and the Southern California Telephone Company for permission to transfer the Home franchise to the merger corporation was set up a week by the public utilities committee in order that the matter may be acted upon with as little delay as possible, and with a consequent saving to the city in the franchise fees collected from the merger corporation, and also for the purpose of saving the public the difference in rates, amounting to $483,000 a year.

TRANSPORTATION.

CALDWELL, IDAHO.—An ordinance has been passed by the city council granting to the Boise Valley Traction Company an electric railway franchise along Cleveland boulevard, the company to construct a single track railway. An ordinance has also been passed granting to the Caldwell Traction Company a franchise to construct an electric railway along Cleveland boulevard and others.

ALBERTON, MONT.—The Chicago, Milwaukee & St. Paul Railway has added 110 miles to its electrically operated lines in Montana. This is the third unit to be changed from steam to electric operation, and extends from Deer Lodge to Alberton. Construction work on the fourth and last unit, from Alberton to Avery, Idaho, will be completed about the first of the year, at which time the railroad will have 440 miles of electric line in operation.

SALT LAKE CITY, UTAH.—Engineers of the Denver & Rio Grande Railway have completed surveys and estimates for the Soldier Summit grades, and plans will be submitted to H. U. Mudge, president of the railroad, who will make recommendations to the board of directors concerning the change from steam to electrical operation from the grades over the Wasatch Mountains. The building of a high-tension line by the Utah Power & Light Company from Provo to Price is said to be the first step in the proposed electrification. It is understood that the cost of power is now being estimated by the Utah Company and that contracts may be tentatively entered into within the next few weeks.

IRRIGATION.

VALE, ORE.—The full amount of $150,000 in bonds of the Warm Springs Irrigation District will be offered for sale in December.

NORTH YAKIMA, WASH.—Selah-Moxee Canal Company has started work tearing out old wooden flume which will be replaced by a flume of Armco iron, the contract for which went to A. B. Fosseen & Co. at $42 000, 12,600 ft.

UPLANDS, CAL.—Indications are that a storm water ditch to carry water from 24th street, east of Euclid and 19th street, will soon be completed, the contract having been drawn and all interested parties having agreed on various details.

GREAT FALLS, MONT.—Work upon the erection of concrete construction of the Greenfields division of the Sun River reclamation project, which was suspended last July, when the contractors of the West Coast Construction Company and Hans Pederson, gave up the work, will be resumed at once, by the sureties upon the original contractor's bonds.

STOCKTON, CAL.—Land owners in the West Side Irrigation District voted in favor of the $295 000 bond issue to furnish funds for the construction of the district's canals, pipe lines and pumping station. The bonds will bear interest at 6 per cent and will be payable in 40 years. No time will be lost in starting the work. The district is about 8 miles long.

TERRA BELLA, CAL.—The board of directors of the Terra Bella Irrigation District have awarded $600,000 first issue bonds to the Contractors' Securities Company of Los Angeles, at 97c on the dollar, the issue bringing $570,000. Immediately after the awarding of the bonds the board awarded the contract for the first unit of the irrigation system to W. A. Kraner of San Francisco, at the stipulated figure of $376,619.

DIXON, CAL.—Promotors of irrigation for the Dixon district have decided to embrace about 25,000 acres in the project instead of 55,000 as first planned, believing they can obtain sufficient signatures for this quantity. Over 2000 acres have already been signed. It is the intention to develop either the Devil's Head or Geunoc reservoir sites, the former, of which, with its distributing system, would cost about $650,000, according to estimate, making the ultimate cost about $26 an acre.

PLACERVILLE, CAL.—While the Railroad Commission has taken no action on the application of the Western States Gas & Electric Company to purchase the Big Ditch water system from the Baring interests, the power company has already done considerable improvement work on the property. The improvements are all in this vicinity and are being made under the supervision of William Albright. One of the most noticeable improvements is the replacing of 520 ft. of wooden 24 in. pipe on Texas Hill pipeline.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co
Los Angeles; 755 Folsom St., San Francisco; Seattle.

B-1 Baker-Joslyn Company 2
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

I-1 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.

C-1 Century Electric Co 3
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co 5
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co 11
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co.....
Chicago, Ill.

D-2 Dearborn Chemical Company 13
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Co 13
206-8-10 First St., (near Howard), San Francisco.

E-3 Electric Agencies Co.....
279-283 Minna St., San Francisco; 419-421 E. Third St., Los Angeles.

E-4 Electric Storage Battery Co.....
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 13
34 Second St., San Francisco.

E-6 Electric Novelty Works.....
533 Mission St., San Francisco.

E-7 Economy Fuse & Mfg. Co.....
Kinzie and Orleans Sts., Chicago.

F-3 Federal Sign System (Electric)..... 4
618 Mission St., San Francisco.

G-1 General Electric Co..... 12
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 Habirshaw Electric Cable Co., Inc.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 13
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co..... 13
428 Market St., San Francisco.

H-4 Hubbard & Co..... 3
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H-7 Hurley Machine Co..... 2
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I-2 Illinois Electric Co.....
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I-3 Interstate Electric Novelty Co.....
111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... 7
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L-2 Locke Insulator Manufacturing Co..... 14
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M-2 McGlauflin Manufacturing Co..... 7
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M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

M-4 Morse Chain Company..... 6
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N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... 12
(All Jobbers.)

N-4 New York Insulated Wire Co..... 12
629 Howard St., San Francisco.

N-6 National Carbon Co..... 13
Cleveland, Ohio.

O-1 Okonite Co. (The)..... 16
(All Jobbers.)

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 13
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P-7 Pittsburgh Piping & Equipment Co..... 16
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S-1 Schaw-Batcher Company, Pipe Works, The.....
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S-4 Southern Pacific Co..... 2
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 11
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S-6 Standard Underground Cable Co..... 3
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 Thomas & Co., R.....
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company.....
Pawtucket, R. I.

U-1 United Sheet Metal Works.....
575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company.....
St. Louis, Mo.

W-2 Western Electric Co..... 3
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co..... 16
Mt. Vernon, New York.

W-4 Westinghouse Electric & Manufacturing Co.....
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; First National Bank Bldg., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.